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(54) **TRANSACTION PLAN MANAGEMENT**

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G06Q 40/00 (2012.01)

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(57) **ABSTRACT**

Aspects of the present invention disclose a method for determining and providing notifications regarding ATMs that can fulfill a transaction plan of a user. The method includes one or more processors determining a transaction plan for a user, the transaction plan including a schedule of future transactions of the user based on historical user data and user-provided information, wherein the determined transaction plan includes a forecast future withdrawal amount and corresponding time. The method further includes one or more processors identifying an automated teller machine (ATM) preferred by the user. The method further includes one or more processors determining whether the ATM preferred by the user can fulfill the determined transaction plan. In response to determining that the ATM preferred by the user cannot fulfill the determined transaction plan, the method further includes determining one or more alternate ATMs that can fulfill the determined transaction plan.

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(58) **Field of Classification Search**

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See application file for complete search history.

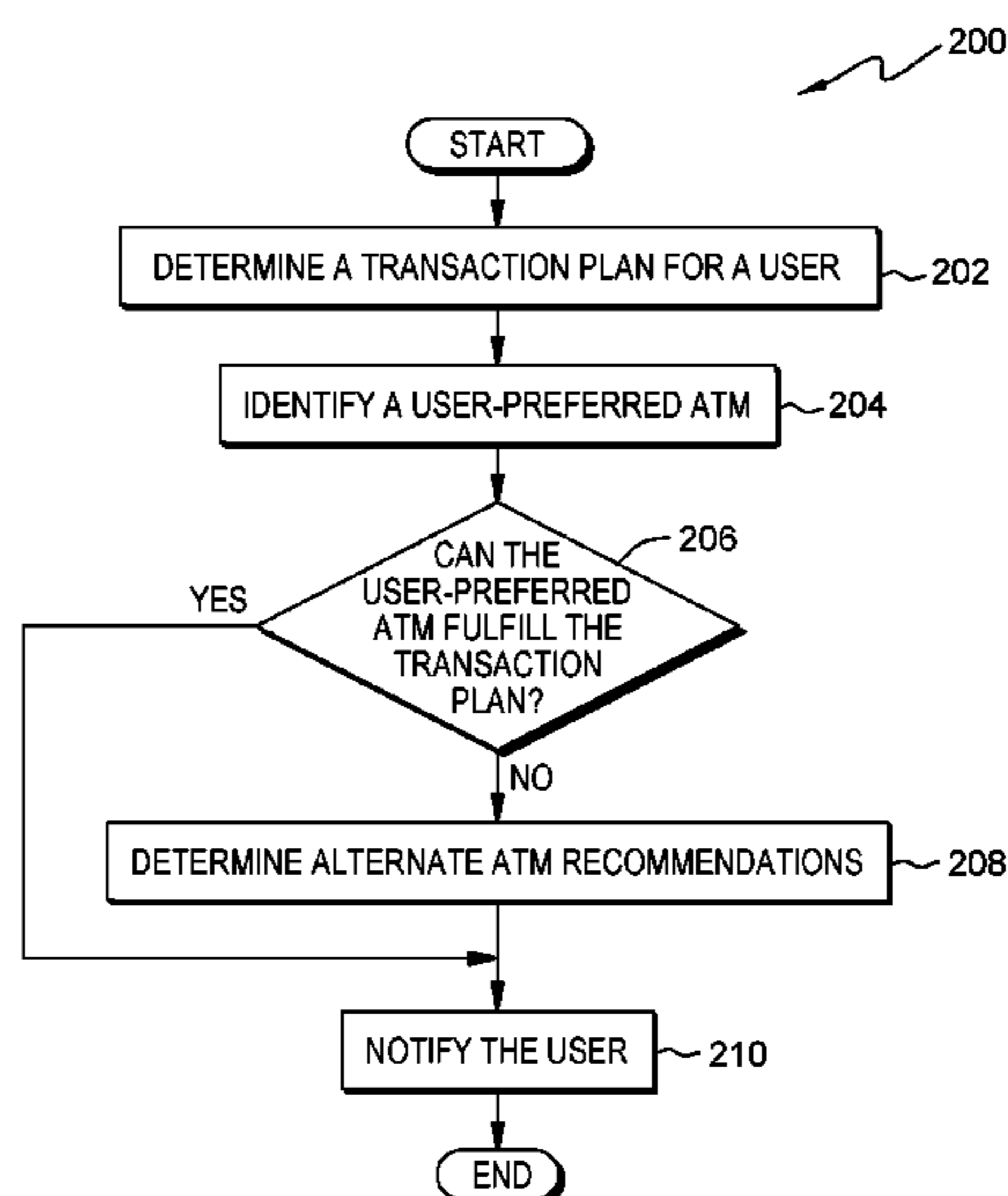
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18 Claims, 4 Drawing Sheets



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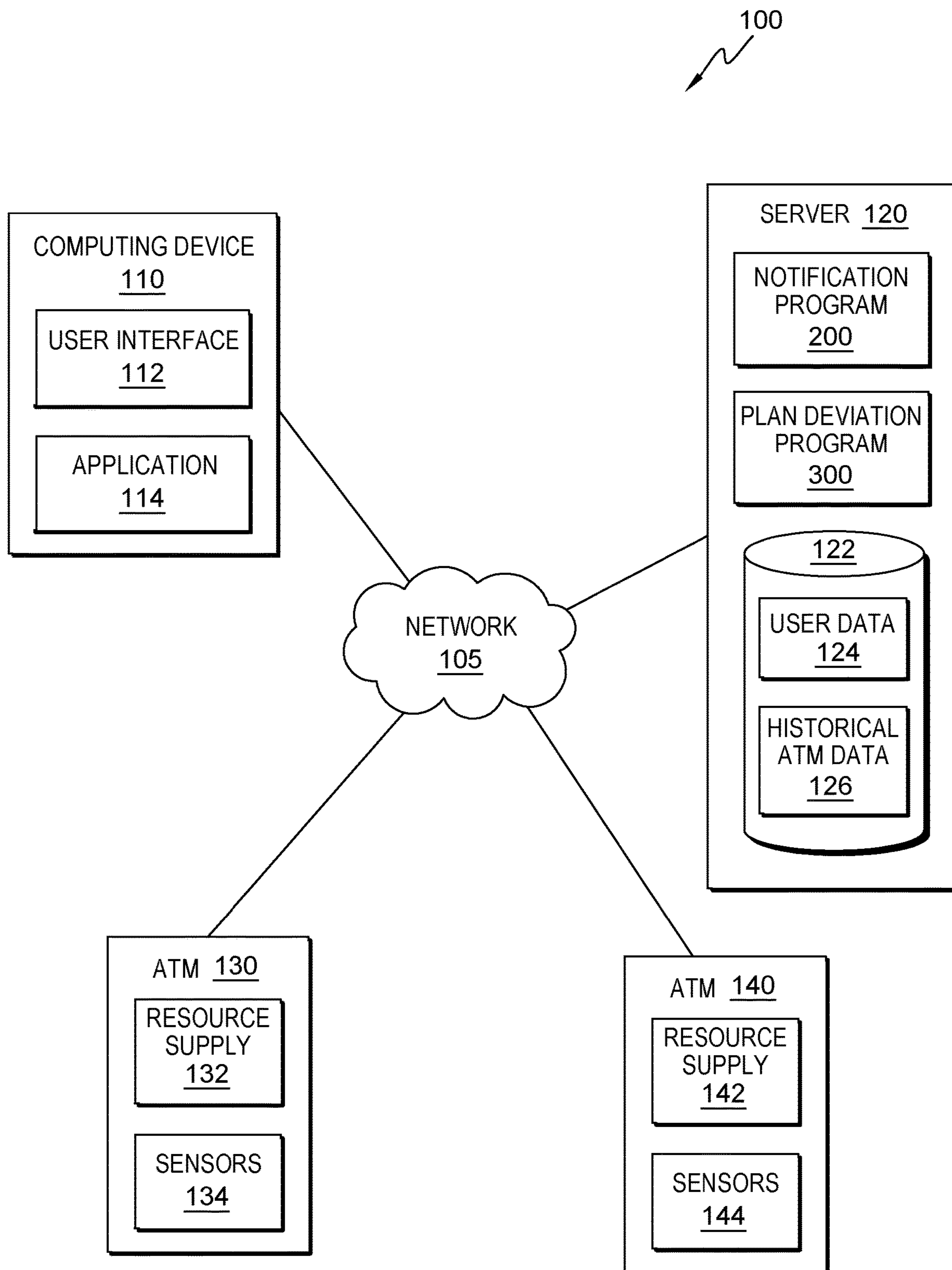


FIG. 1

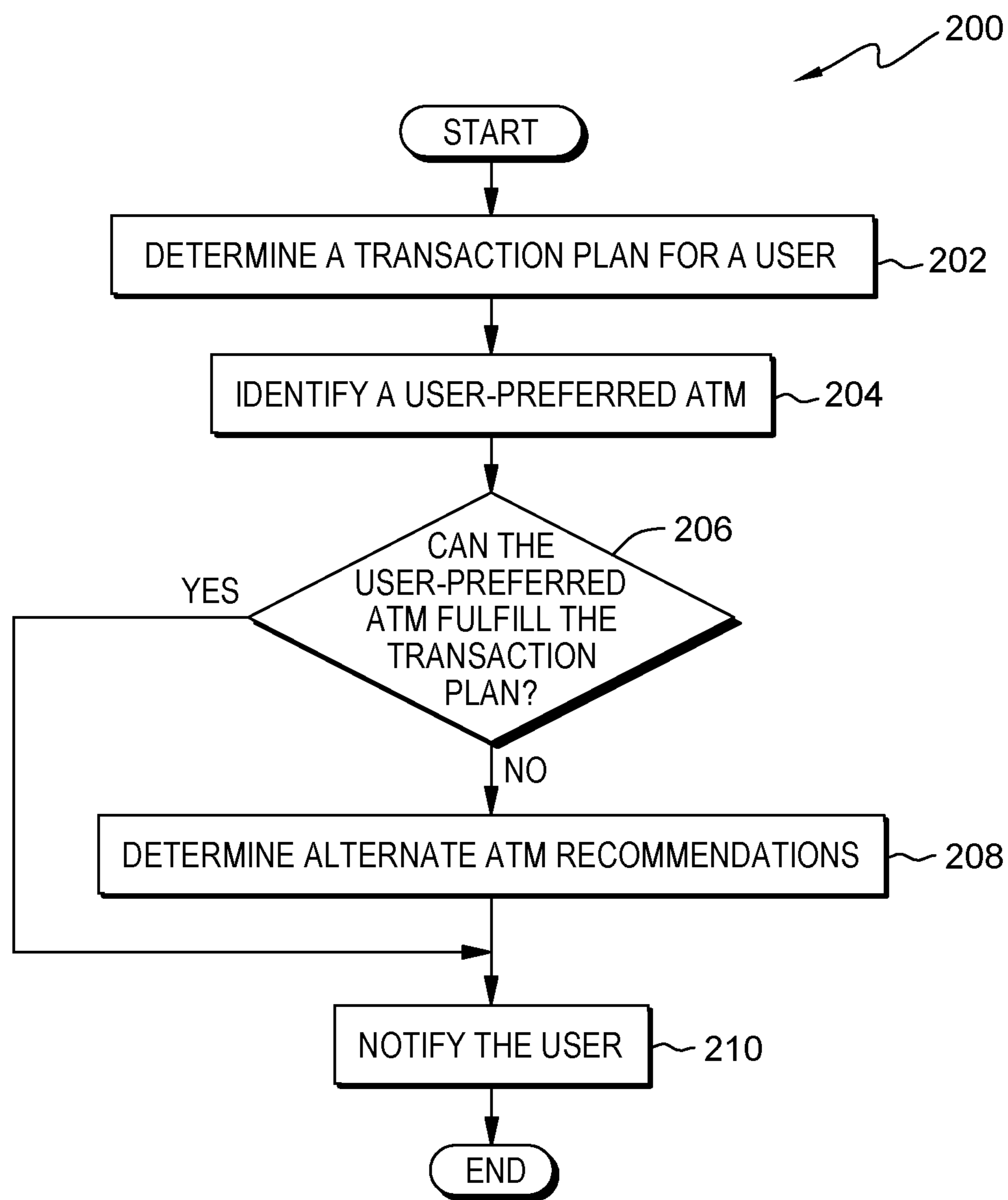


FIG. 2

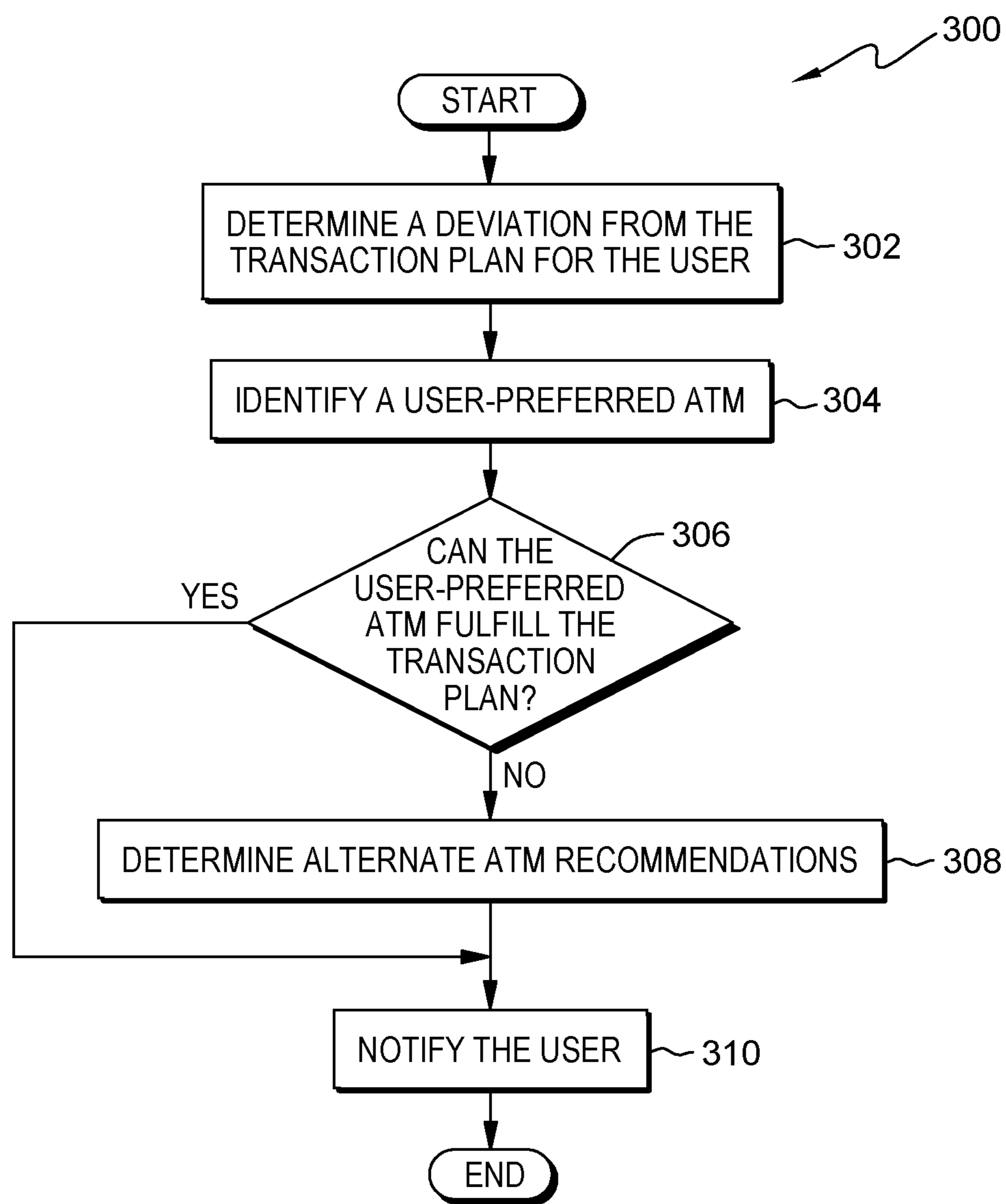


FIG. 3

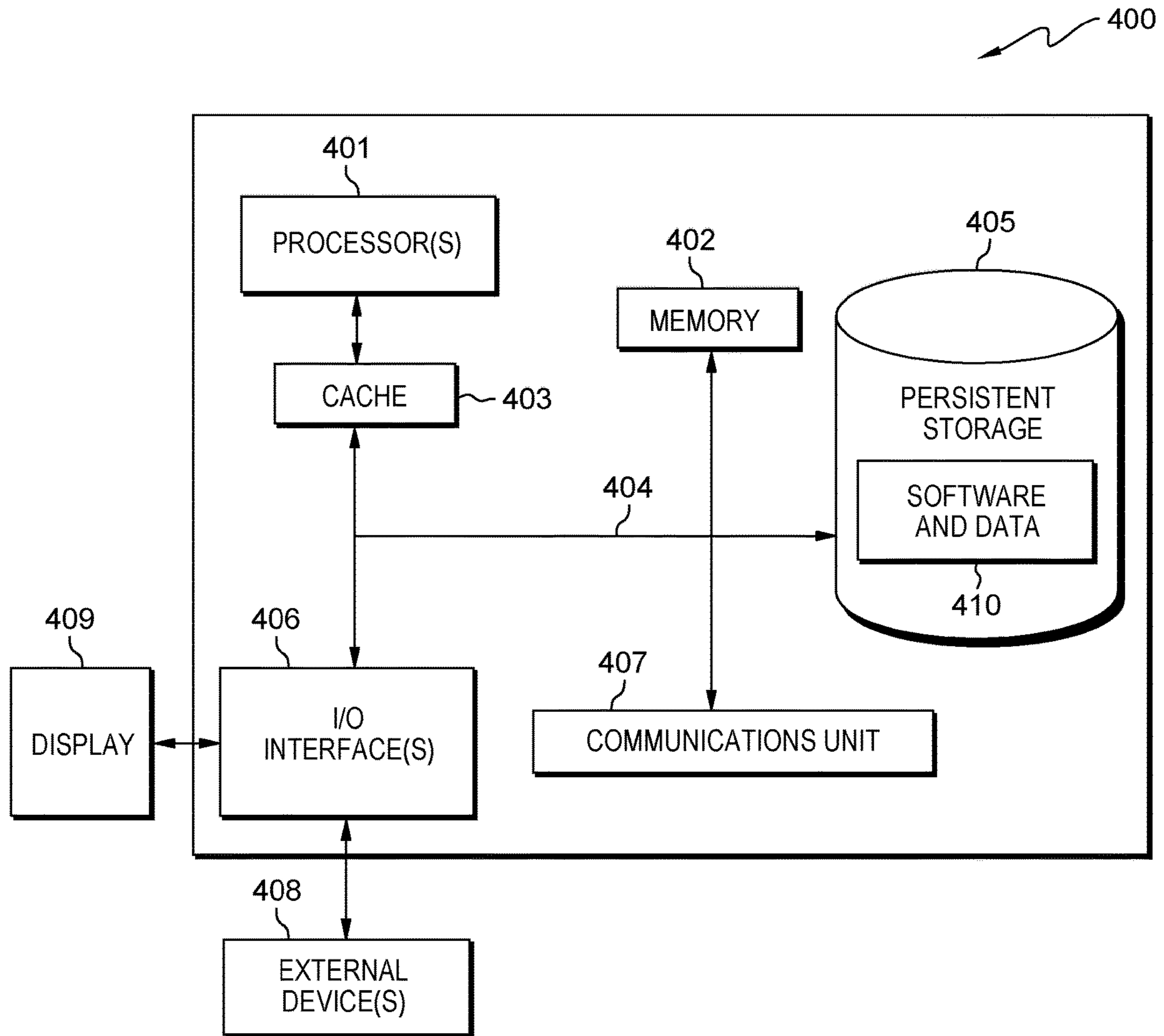


FIG. 4

1**TRANSACTION PLAN MANAGEMENT**

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of data analytics, and more particularly to managing a transaction plan for a user.

An automated teller machine (ATM) is an electronic telecommunications device that enables customers of financial institutions to perform financial transactions, such as cash withdrawals, deposits, transfer funds, or obtaining account information, without the need for direct interaction with bank staff. ATMs are known by a variety of names, including automatic teller machine (ATM) (e.g., in the United States), often redundantly ATM machine, automated banking machine (ABM) (e.g., in Canada), cash point, cash machine, minibank, etc.

Using an ATM, customers can access their bank deposit or credit accounts in order to make a variety of financial transactions most notable cash withdrawals but also check balances, or credit mobile phones. ATMs can be used to withdraw cash in a foreign country. Customers are typically identified by inserting a plastic ATM card (or some other acceptable payment card) into the ATM, with authentication being by the customer entering a personal identification number (PIN), which must match the PIN stored in the chip on the card (if the card is so equipped), or in the issuing financial institution's database. Customers can also interface with an ATM (or a network of a corresponding instruction) via an application, such as an app installed on a smartphone.

SUMMARY

Aspects of the present invention disclose a method, computer program product, and system for determining and providing notifications regarding ATMs that can fulfill a transaction plan of a user. The method includes one or more processors determining a transaction plan for a user, the transaction plan including a schedule of future transactions of the user based on historical user data and user-provided information, wherein the determined transaction plan includes a forecast future withdrawal amount and corresponding time. The method further includes one or more processors identifying an automated teller machine (ATM) preferred by the user. The method further includes one or more processors determining whether the ATM preferred by the user can fulfill the determined transaction plan. In response to determining that the ATM preferred by the user cannot fulfill the determined transaction plan, the method further includes determining one or more alternate ATMs that can fulfill the determined transaction plan.

In another embodiment, the method further includes one or more processors determining whether the user has deviated from the determined transaction plan based on completed transactions of the user.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a functional block diagram of a data processing environment, in accordance with an embodiment of the present invention.

FIG. 2 is a flowchart depicting operational steps of a program for determining and providing notifications regarding ATMs that can fulfill a transaction plan of a user, in accordance with an embodiment of the present invention.

FIG. 3 is a flowchart depicting operational steps of a program for determining and providing notifications regard-

2

ing ATMs that can fulfill a deviation to a transaction plan of a user, in accordance with embodiments of the present invention.

FIG. 4 depicts a block diagram of components of a computing system representative of the computing device, and server of FIG. 1, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention allow for gathering and utilizing historical user data and data associated with automated teller machines (ATMs) to determine a transaction plan for a user. The transaction plan includes a schedule of future transactions of the user (i.e., spending and withdrawing money) based on historical data and user-provided information. Embodiments of the present invention can identify a user-preferred ATM (e.g., based on historical usage) and determine whether the identified ATM can satisfy the determined transaction plan for the user. In response to determining that the user-preferred ATM cannot satisfy the determined transaction plan for the user, additional embodiments of the present invention can identify and recommend a suitable substitute ATM to the user.

Further, embodiments of the present invention can leverage a plurality of additional factors in the determination of whether an ATM can satisfy a transaction plan (e.g., a travel route of a user, indication of urgency, resource supplies of ATMs, etc.). In another embodiment, a deviation in the transaction plan for the user is identified. Accordingly, embodiments of the present invention can determine whether the identified user-preferred ATM can satisfy the identified deviation in the transaction plan for the user. In response to determining that the user-preferred ATM cannot satisfy the identified deviation in the transaction plan for the user, embodiments of the present invention can identify and recommend a suitable substitute ATM to the user.

Some embodiments of the present invention provide improvements by providing ATM recommendations to user based on resource supply (e.g., money, paper, etc.) and predictive analytics. Embodiments of the present invention can operate to distribute the resource utilization across ATMs based on real-time analysis of demand, which reduces downtime of a distributed ATM network and also significant increases availability and efficiency.

Implementation of embodiments of the invention may take a variety of forms, and exemplary implementation details are discussed subsequently with reference to the Figures.

The present invention will now be described in detail with reference to the Figures. FIG. 1 is a functional block diagram illustrating a distributed data processing environment, generally designated **100**, in accordance with one embodiment of the present invention. FIG. 1 provides only an illustration of one implementation and does not imply any limitations with regard to the environments in which different embodiments may be implemented. Many modifications to the depicted environment may be made by those skilled in the art without departing from the scope of the invention as recited by the claims.

An embodiment of data processing environment **100** includes computing device **110**, server **120**, ATM **130**, and ATM **140**, all interconnected over network **105**. In an example embodiment, an individual associated with and/or utilizing computing device **110** utilizes one or more of ATM **130** and ATM **140**. In this example embodiment, server **130** can provide a recommendation to utilize ATM **130** or ATM

140 to computing device **110**, in accordance with various embodiments of the present invention.

Network **105** can be, for example, a local area network (LAN), a telecommunications network, a wide area network (WAN), such as the Internet, or any combination of the three, and include wired, wireless, or fiber optic connections. In general, network **105** can be any combination of connections and protocols that will support communications between computing device **110**, server **120**, ATM **130**, and ATM **140**, in accordance with embodiments of the present invention. In various embodiments, network **105** facilitates communication among a plurality of networked ATMs (e.g., ATM **130** and ATM **140**), corresponding users (e.g., an individual utilizing computing device **110**), and corresponding management services (e.g., server **120**).

In various embodiments of the present invention, computing device **110** may be a workstation, personal computer, personal digital assistant, mobile phone, or any other device capable of executing computer readable program instructions, in accordance with embodiments of the present invention. In general, computing device **110** is representative of any electronic device or combination of electronic devices capable of executing computer readable program instructions. Computing device **110** may include components as depicted and described in further detail with respect to FIG. **4**, in accordance with embodiments of the present invention. In an example embodiment, computing device **110** is a smart device, such as a smartphone, a smart watch, etc.

Computing device **110** includes user interface **112** and application **114**. User interface **112** is a program that provides an interface between a user of computing device **110** and a plurality of applications that reside on the computing device (e.g., application **114**). A user interface, such as user interface **112**, refers to the information (such as graphic, text, and sound) that a program presents to a user, and the control sequences the user employs to control the program. A variety of types of user interfaces exist. In one embodiment, user interface **112** is a graphical user interface. A graphical user interface (GUI) is a type of user interface that allows users to interact with electronic devices, such as a computer keyboard and mouse, through graphical icons and visual indicators, such as secondary notation, as opposed to text-based interfaces, typed command labels, or text navigation. In computing, GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces which require commands to be typed on the keyboard. The actions in GUIs are often performed through direct manipulation of the graphical elements. In another embodiment, user interface **112** is a script or application programming interface (API).

Application **114** can be representative of one or more applications (e.g., an application suite) that operate on computing device **110**. In an example embodiment, application **114** is a client-side application of an enterprise associated with server **120**, ATM **130**, and ATM **140**. In another example embodiment, application **114** is a web browser that an individual utilizing computing device **110** utilizes (e.g., via user interface **112**) to access information over network **105**, such as services associated with ATM **130** and ATM **140** or provided by an enterprise associated with server **120**. In other aspects of the present invention, application **114** can be representative of applications that provide additional functionality (e.g., camera, messaging, etc.), in accordance with various aspects of the present invention.

In example embodiments, server **120** can be a desktop computer, a computer server, or any other computer systems, known in the art. In certain embodiments, server **120** rep-

resents computer systems utilizing clustered computers and components (e.g., database server computers, application server computers, etc.) that act as a single pool of seamless resources when accessed by elements of data processing environment **100** (e.g., computing device **110**, ATM **130**, and ATM **140**). In general, server **120** is representative of any electronic device or combination of electronic devices capable of executing computer readable program instructions. Server **120** may include components as depicted and described in further detail with respect to FIG. **4**, in accordance with embodiments of the present invention.

Server **120** includes notification program **200**, plan deviation program **300**, and storage device **122**, which includes user data **124** and historical ATM data **126**. In one embodiment, server **120** is associated with a particular enterprise (e.g., a business or financial institution) that manages a network of ATMs, including ATM **130** and ATM **140**. In one embodiment, notification program **200** can determine and provide notifications regarding ATMs that can fulfill a transaction plan of a user, in accordance with embodiments of the present invention. In additional embodiments, in response to determining that a user-preferred ATM cannot fulfill the transaction plan corresponding to the user, notification program **200** can determine and provide recommendations of alternate ATMs that can fulfill the transaction plan.

In another embodiment, plan deviation program **300** detects a deviation from the transaction plan corresponding to a user, and accordingly can determine and provide notifications regarding ATMs that can fulfill the transaction plan, including the deviation, for the user, in accordance with embodiments of the present invention. In additional embodiments, in response to determining that a user-preferred ATM cannot fulfill the deviation in the transaction plan corresponding to the user, plan deviation program **300** can determine and provide recommendations of alternate ATMs that can fulfill the transaction plan.

Storage device **122** can be implemented with any type of storage device, for example, persistent storage **405**, which is capable of storing data that may be accessed and utilized by server **120**, computing device **110**, ATM **130**, and ATM **140**, such as a database server, a hard disk drive, or a flash memory. In other embodiments, storage device **122** can represent multiple storage devices and collections of data within server **120**. In various embodiments, storage device **122** includes information that notification program **200** and plan deviation program **300** access and utilize, in accordance with embodiments of the present invention. Storage device **122** includes user data **124** and historical ATM data **126**.

In example embodiments, user data **124** includes information associated with registered users of an enterprise that manages ATM **130** and ATM **140** (e.g., a financial institution), in accordance with embodiments of the present invention. For example, an individual utilizing computing device **110** completes a registration process, provides information, and authorizes the collection and analysis (i.e., opt-in) of data associated with the individual, by server **130** (e.g., via notification program **200** and plan deviation program **300**). In this example, the individual can authorize server **120** to utilize a camera of an ATM to identify the individual and also authorize server **120** to monitor transaction information of the individual to determine a transaction plan. In other examples, the individual can provide authorization of a subset of categories of data collection (i.e., opt-in out of certain categories of data collection).

In one embodiment, user data **124** includes user profile information for respective users, such as user identification

information. For example, user data **124** includes an image, or other user-provided biometric information, that server **130** can utilize to identify a user (e.g., in reference to real-time camera information from an ATM, such as from sensors **134** and sensors **144**, for facial recognition). In another embodiment, user data **124** includes information associated with how respective users utilize ATMs. For example, user data **124** includes a favorite and/or normal withdrawal amount and a withdrawal pattern associated with the individual utilizing computing device **110**.

In a further embodiment, user data **124** includes a transaction plan, and corresponding information, for a user, such as an individual utilizing computing device **110**. The transaction plan includes a schedule of future transactions of the user (i.e., spending and withdrawing money) based on historical data and user-provided information. In other embodiments, user data **124** includes additional information associated with use of an ATM, such as user card health information, user-provided calendar information, user access profile information (e.g., ATM accessibility requirements). User data **124** can also include user preference information, such as a user-preferred ATM (e.g., ATM **130**), user notification preferences, user-provided scheduling information, etc.

In various embodiments, historical ATM data **126** includes historical usage information for specific ATMs managed by server **120** (e.g., ATM **130** and ATM **140**), in accordance with embodiments of the present invention. For example, historical ATM data **126** includes respective historical transaction information for a specific ATM, such as ATM **130**. In additional embodiments, historical ATM data **126** includes information that notification program **200** and plan deviation program **300** can access and utilize, in accordance with embodiments of the present invention. For example, notification program **200** can access historical ATM data **126** to determine whether ATM **130** can satisfy a transaction plan associated with an individual utilizing computing device **110**. In another example, notification program **200** can access historical ATM data **126** to determine whether an alternate ATM (e.g., ATM **140**) can satisfy a transaction plan associated with an individual utilizing computing device **110**.

ATM **130** and ATM **140** are representative of automated teller machines that are associated with an enterprise associated with server **120**, in accordance with embodiments of the present invention. In an example embodiment, an individual utilizing computing device **110** is registered to utilize ATM **130** and ATM **140** (e.g., is a member of a corresponding financial institution). In various embodiments, ATM **130** and ATM **140** are part of a network of ATMs (e.g., a plurality of ATMs associated with a particular financial institution), which are managed by server **120**, in accordance with various embodiments of the present invention. ATM **130** and ATM **140** include respective instances of resource supplies (i.e., resource supply **132** and resource supply **142**) and sensors (i.e., sensors **134** and sensors **144**).

In one embodiment, resource supply **132** and resource supply **142** include information indicating an amount of resources that a respective instance of ATM **130** and ATM **140** contain. In an example scenario, the resources include a supply of cash contained within an ATM, which is updated in response to each transaction at an ATM. In another scenario, the resources can also include an amount of receipt paper, or other quantifiable resource, contained within an ATM.

In example embodiments, sensors **134** and sensors **144** includes cameras and other sensors (e.g., microphone, etc.),

associated with a respective instance of ATM **130** and ATM **140**, that server **130** can access and utilize in accordance with various embodiments of the present invention. Embodiments of the present invention utilize sensors **134** and sensors **144** to gather user-authorized information for users of ATM **130** and ATM **140**. For example, server **120** can utilize a camera, of sensors **134**, to perform facial recognition on an individual utilizing computing device **110** to identify the individual while in line at ATM **130**, when the individual has authorized facial recognition identification (e.g., in user data **124**). In another embodiment, server **120** can access a camera, of sensors **134**, at ATM **130** to identify a length of a queue at ATM **130**.

In an additional embodiment, sensors **134** and sensors **144** can monitor respective instances of resource supply **132** and resource supply **142** and convey corresponding data to server **120**. In a further example, server **120** can utilize sensors of an ATM to identify a user that is in proximity to an ATM to predict whether the user is a potential customer for the ATM. In another embodiment, sensors **134** and sensors **144** can include sensors that monitor a health of a card provided by a user, to determine whether a failed transaction is the result of a damaged card. In this embodiment, server **120** can provide a notification to the user corresponding to the damaged card.

FIG. **2** is a flowchart depicting operational steps of notification program **200**, a program for determining and providing notifications regarding ATMs that can fulfill a transaction plan of a user, in accordance with embodiments of the present invention. In one embodiment, notification program **200** initiates periodically to determine, or update, a transaction plan for a user. In another embodiment, notification program **200** initiates in response to a user request (e.g., via user input into user interface **112** of computing device **110**). In an additional embodiment, notification program **200** can operate as a background process that analyzes (user authorized) collected data associated with a user.

In step **202**, notification program **200** determines a transaction plan for a user. The transaction plan includes a schedule of future transactions of the user (i.e., spending and withdrawing money) based on historical data and user-provided information. In one embodiment, notification program **200** generated a new transaction plan for a user. In another embodiment, notification program **200** identifies an existing transaction plan associated with a user (e.g., in user data **124**), which notification program **200** can utilize or update with new information associated with the user. In an example embodiment, the transaction plan corresponds to a specified time frame (e.g., a transaction plan for the coming week, the next three days, today, etc.), which notification program **200** can determine based on historical transaction and ATM usage information associated with the user (from user data **124**).

In various embodiments, notification program **200** analyzes historical transaction information, from user data **124**, associated with a user to determine the transaction plan for the user. Notification program **200** can also utilize user-provided information (e.g., real-time information) to determine the transaction plan for the user. For example, an individual utilizing computing device **110** provides input that forecasts upcoming transactions and/or ATM activity that notification program **200** determines is relevant to the transaction plan.

In an example scenario, notification program **200** access user data **124** associated with an individual utilizing computing device **110** (i.e., historical data) and identifies input into computing device **110** indicating future transactions of

the individual (i.e., real-time data). In this scenario, notification program **200** determines a transaction plan for the individual utilizing computing device **110** based on the historical information and the real-time information. For example, notification program **200** determines that the individual currently has \$500 and, based on the historical data and real-time data, the individual is projected to spend \$400 over the next three days. Notification program **200** can then determine (also based on the historical data and real-time data) that the individual is projected to utilize an ATM in four days and is forecast to withdraw \$600 (e.g., user favorite amount, user-indicated amount, etc.).

In an alternate scenario, an individual utilizing computing device **110** indicates that the individual will withdraw \$500 from an ATM tomorrow. In this scenario, notification program **200** determines the transaction plan to be that the user will withdraw \$500 tomorrow.

In step **204**, notification program **200** identifies a user-preferred ATM. In various embodiments, notification program **200** determines the user-preferred ATM based on user data **124**, an optionally an indication in historical ATM data **126**. In one embodiment, notification program **200** identifies the user-preferred ATM utilizing an indication in a corresponding instance of user data **124**. In another embodiment, notification program **200** determines that the most frequently used ATM (based on information in user data **124**) is the user-preferred ATM. In additional embodiments, notification program **200** can leverage additional criteria to determine the user-preferred ATM, such as user provided calendar information, travel route information, user selection, etc. In an example scenario, notification program **200** determines that ATM **130** is the user-preferred ATM of the individual utilizing computing device **110**, based on the corresponding instance of user data **124**.

In decision step **206**, notification program **200** determines whether the user-preferred ATM can fulfill the transaction plan. In one embodiment, notification program **200** determines whether the resource supply of the user-preferred ATM (e.g., resource supply **132** of ATM **130**) can fulfill the transaction plan (determined in step **202**). Notification program **200** can also leverage an instance of historical ATM data **126** that corresponds to the user-preferred ATM to determine whether the user-preferred ATM can fulfill the transaction plan. In an additional embodiment, notification program **200** identifies a forecast withdrawal amount and date from the determined transaction plan (from step **202**) and predicts whether the user-preferred ATM can fulfill the forecast transaction on the date (e.g., based on the resource supply and historical ATM data **126**).

In an example, notification program **200** determines that the transaction plan indicated a forecast \$300 cash withdrawal for today. In this example, notification program **200** determined the user-preferred ATM to be ATM **130** (in step **204**). Accordingly, notification program **200** determines whether ATM **130** can fulfill the forecast transaction at a predicted time of day, based on resource supply **132** and historical ATM data **126**. In another example, notification program **200** can determine whether the user-preferred ATM is out of service. If an ATM is out of service or forecast to be out of service at a predicted withdrawal time, then notification program **200** determines that the ATM cannot fulfill the transaction plan.

In another embodiment, notification program **200** can wait at decision step for more information, or until a defined time prior to a predicted ATM withdrawal of a transaction plan (e.g., one day, 2 hours, etc.), before determining whether the user-preferred ATM can fulfill the transaction

plan. In another aspect of the present invention, notification program **200** can aggregate transaction plans and ATM requests from a plurality of users (in user data **124**) to determine whether the user-preferred ATM will be able to fulfill a forecast transaction at a future time. For example, notification program **200** can determine that a high number of users are associated with transaction plans that forecast withdrawing money from ATM **130** during a specific time frame on a specific day.

In step **208**, notification program **200** determines alternate ATM recommendations. More specifically, in response to determining that the user-preferred ATM cannot fulfill the transaction plan (decision step **206**, NO branch), notification program **200** determines alternate ATM recommendations (step **208**). In one embodiment, in response to determining that the user-preferred ATM cannot fulfill the transaction plan (decision step **206**, NO branch), notification program **200** analyzes entries in historical ATM data **126** and resource supplies (e.g., resource supply **142**) of a plurality of ATMs accessible over network **105**. Notification program **200** can then determine one or more recommended alternate ATMs that can fulfill the transaction plan (e.g., ATM **140** and other accessible ATMs (not shown)).

For example, notification program **200** determines (in decision step **206**) that ATM **130** cannot fulfill the determined transaction plan for the user (from step **202**). In this example, notification program **200** determines an alternate ATM recommendation of ATM **140**, based on resource supply **142** and historical ATM data **126**.

Notification program **200** can also utilize additional factors in the determination of alternate ATMs (e.g., utilizing information in user data **124**, etc.). In one scenario, notification program **200** can utilize a location of a user (e.g., computing device **110**) and/or user-provided travel path information to identify candidate alternate ATMs and then determine alternate ATM recommendations. In this scenario, notification program **200** identifies ATMs that are near the route that the user travels on when commuting to work (e.g., or other user-provided navigation information or authorized navigation history in user data **124**). Notification program **200** can then, from the identified ATMs near the route, determine one or more recommended alternate ATMs, taking into account the respective ATM resource supplies and information from historical ATM data **126**.

In another scenario, notification program **200** identifies a plurality of candidate alternate ATMs (e.g., based on real-time user data, user data **124**, etc.) and forecasts the resource supply for the candidate ATMs at a predicted withdrawal time from the transaction plan. For example, notification program **200** analyzes resource supply **142** of ATM **140** and corresponding information in historical ATM data **126** (e.g., historical resource usage) to forecast the contents of resource supply **142** at an estimated cash withdrawal time from the determined transaction plan (of step **202**). In this example, if notification program **200** determines that the forecast contents of resource supply **142** at the estimated cash withdrawal time will fulfil the transaction plan, then notification program **200** includes ATM **140** as an alternate ATM recommendation.

In additional scenarios, notification program **200** can utilize user calendar information (e.g., provided by the user and stored in user data **124**) as parameters in determining alternate ATM recommendations. Further, notification program **200** can also utilize the calendar information to recommend alternate withdrawal times to the user (e.g., to accompany the alternate ATM recommendations, or for the user to wait to withdraw), which can augment the transaction

plan. Accordingly, notification program **200** can recommend alternate ATMs based on a time and distance in relation to existing user scheduled commitments and/or appointments (e.g., upcoming travel, indicated urgency, etc.). In another embodiment, notification program **200** utilizes user-provided accessibility requirements (from user data **124**) in determining candidate alternate ATMs, such as ramp accessibility, visual assistance, etc.

In a further embodiment, notification program **200** can identify and utilize additional charges associated with ATM usage in the determination of alternate ATM recommendations. For example, notification program **200** can determine additional charges (e.g., ATM fees, etc.) associated with usage of a particular ATM by a particular user (e.g., additional charges may apply when a user utilizes an ATM associated with a bank that the user does not have an account with, etc.). In this example, notification program **200** utilizes the additional charges as a factor in determining the alternate ATM recommendations.

In step **210**, notification program **200** notifies the user. In one embodiment, in response to determining that the user-preferred ATM can fulfill the transaction plan (decision step **206**, YES branch), notification program **200** notifies the user that the user-preferred ATM can fulfill the transaction plan (step **210**). Optionally, in response to determining that the user-preferred ATM can fulfill the transaction plan (decision step **206**, YES branch), notification program **200** can terminate without sending notification to the user. In another embodiment, subsequent to determining alternate ATM recommendations (in step **208**), notification program **200** send the user a notification that indicates that the user-preferred ATM cannot fulfill the transaction plan and includes the determines alternate ATM recommendations (from step **208**). In various embodiments, notification program **200** identifies user preferences for notifications (e.g., in user data **124**) and tailors the notification accordingly.

In example embodiments, notification program **200** notifies an individual utilizing computing device **110** by communicating the notification to application **114**. Accordingly, notification program **200** can send the user a notification that includes one of more of: an indication of a recommended alternate ATM (e.g., ATM **140**), information to accompany the recommendation (e.g., reasoning behind the recommendation to utilize the alternate ATM, highlighting an increase in time or distance relative to the user-preferred ATM, etc.), a plurality of recommended alternate ATMs that the user can select from, a recommendation to wait until a specified time to make a withdrawal from the user-preferred ATM or an alternate ATM, a recommendation to visit an ATM because the user is travelling on a route that is not near an active ATM, information indicating a health status associated with a ATM access card of the user, and other information that can be specified by user preferences (e.g., in user data **124**).

In various embodiments, an individual utilizing computing device **110** can interact with the notification (e.g., via user interface **112** and application **114**) to select a recommendation of an ATM, which notification program **200** can utilize to update the transaction plan. In additional embodiments, the individual utilizing computing device **110** has the option to accept or reject the recommendation in the notification, after which notification program **200** can terminate or re-initiate. In an alternate embodiment, subsequent to providing the notification, or receiving a user selection of a recommendation, notification program **200** can re-initiate after a defined period of time (i.e., periodically).

FIG. **3** is a flowchart depicting operational steps of plan deviation program **300**, a program for determining and

providing notifications regarding ATMs that can fulfill a deviation to a transaction plan of a user, in accordance with embodiments of the present invention. In one embodiment, plan deviation program **300** initiates periodically to detect whether a user has deviated from a corresponding transaction plan. In another embodiment, plan deviation program **300** initiates in response to receiving new or updated information relevant to a transaction plan associated with a user. In an additional embodiment, plan deviation program **300** initiates in response to receiving an indication of a deviation from a transaction plan (e.g., via user input into computing device **110**).

In step **302**, plan deviation program **300** determines a deviation from the transaction plan for the user. In one embodiment, plan deviation program **300** analyzes completed transactions of the user (e.g., amount of transactions, dollar amount, pattern, etc.) to determine whether the user has deviated from the determined transaction plan (determined in step **202** of notification program **200** and/or stored associated with the user in user data **124**). In one scenario, plan deviation program **300** can utilize a defined threshold (e.g., defined amount of money, defined number of transaction, etc.) in relation to the transaction plan to determine whether current user activity is a deviation from the transaction plan. In an alternate scenario, plan deviation program **300** receives an indication from a user that the user is deviating (or had deviated) from the transaction plan. In another alternate scenario, plan deviation program **300** receives an indication that a resource supply of an ATM has deviated from a forecast amount, which can impact the transaction plan (e.g., an ATM activity deviation).

In an example embodiment, for the initial (e.g., baseline) transaction plan, an individual currently has \$500 and, based on the historical data and real-time data, the individual is projected to spend \$400 over the next three days. The transaction plan indicates that the individual is projected to utilize an ATM in four days and is forecast to withdraw \$600 (e.g., user favorite amount, user-indicated amount, etc.). In this example, plan deviation program **300** receives or identifies new information, which includes transactions in the amount of \$450 over the first two days of the transaction plan. Accordingly, plan deviation program **300** determines (e.g., based on a transaction monetary amount threshold) that the individual has deviated from the initial transaction plan. Plan deviation program **300** can then determine a deviated transaction plan for the individual, which projects that the individual will utilize an ATM to withdraw \$600 the next day (i.e., on day prior to the projection of the initial transaction plan). In alternate example embodiments, plan deviation program **300** can identify that an individual has completes less transactions than included in an initial transaction plan. Accordingly, plan deviation program **300** can determine a deviated transaction plan that projects an ATM withdrawal at a later time than in the initial transaction plan.

In various embodiments of the present invention, subsequent to determining a deviation from the transaction plan for the user (step **302**), plan deviation program **300** can proceed with similar processes as steps **204-210** of notification program **200**. Accordingly, embodiments of the present invention provide plan deviation program **300** to include the operational capabilities of notification program, previously discussed in further detail with regard to FIG. **2**.

In step **304**, plan deviation program **300** identifies a user-preferred ATM. In various embodiments, plan deviation program **300** determines the user-preferred ATM based on user data **124**, an optionally an indication in historical ATM data **126**. In one embodiment, plan deviation program **300**

identifies the user-preferred ATM utilizing an indication in a corresponding instance of user data **124**. In another embodiments, plan deviation program **300** determines that the most frequently used ATM (based on information in in user data **124**) is the user-preferred ATM. In additional embodiments, plan deviation program **300** can leverage additional criteria to determine the user-preferred ATM, such as user provided calendar information, travel route information, user selection, etc. In an example scenario, plan deviation program **300** determines that ATM **130** is the user-preferred ATM of the individual utilizing computing device **110**, based on the corresponding instance of user data **124**.

In decision step **306**, plan deviation program **300** determines whether the user-preferred ATM can fulfill the transaction plan. In one embodiment, plan deviation program **300** determines whether the resource supply of the user-preferred ATM (e.g., resource supply **132** of ATM **130**) can fulfill the deviated transaction plan (determined in step **302**). Plan deviation program **300** can also leverage an instance of historical ATM data **126** that corresponds to the user-preferred ATM to determine whether the user-preferred ATM can fulfill the transaction plan. In an additional embodiment, plan deviation program **300** identifies an updated forecast withdrawal amount and date from the deviated transaction plan (from step **302**) and predicts whether the user-preferred ATM can fulfill the forecast transaction on the date (e.g., based on the resource supply and historical ATM data **126**).

In step **308**, plan deviation program **300** determines alternate ATM recommendations. More specifically, in response to determining that the user-preferred ATM cannot fulfill the transaction plan (decision step **306**, NO branch), plan deviation program **300** determines alternate ATM recommendations (step **308**). In one embodiment, in response to determining that the user-preferred ATM cannot fulfill the deviated transaction plan (decision step **206**, NO branch), plan deviation program **300** analyzes entries in historical ATM data **126** and resource supplies (e.g., resource supply **142**) of a plurality of ATMs accessible over network **105**. Plan deviation program **300** can then determine one or more recommended alternate ATMs that can fulfill the transaction plan (e.g., ATM **140** and other accessible ATMs (not shown)), including de determined deviation (from step **302**). In various embodiments, plan deviation program **300** can determine and identify alternate ATMs similarly to step **308** of notification program **200** (discussed previously with regard to FIG. 2).

In step **310**, plan deviation program **300** notifies the user. In one embodiment, in response to determining that the user-preferred ATM can fulfill the deviated transaction plan (decision step **306**, YES branch), plan deviation program **300** notifies the user that the user-preferred ATM can fulfill the transaction plan (step **310**). In example embodiments, the notification can include an indication of the deviation in the transaction plan, along with the alternate ATM recommendations. Optionally, in response to determining that the user-preferred ATM can fulfill the transaction plan (decision step **306**, YES branch), plan deviation program **300** can terminate without sending notification to the user. In another embodiment, subsequent to determining alternate ATM recommendations (in step **308**), plan deviation program **300** send the user a notification that indicates that the user-preferred ATM cannot fulfill the transaction plan and includes the determines alternate ATM recommendations (from step **308**). In various embodiments, plan deviation

program **300** identifies user preferences for notifications (e.g., in user data **124**) and tailors the notification accordingly.

In example embodiments, plan deviation program **300** notifies an individual utilizing computing device **110** by communicating the notification to application **114**. Accordingly, plan deviation program **300** can send the user a notification that includes one of more of: an indication of a recommended alternate ATM (e.g., ATM **140**), information to accompany the recommendation (e.g., reasoning behind the recommendation to utilize the alternate ATM, highlighting an increase in time or distance relative to the user-preferred ATM, etc.), a plurality of recommended alternate ATMs that the user can select from, a recommendation to wait until a specified time to make a withdrawal from the user-preferred ATM or an alternate ATM, a recommendation to visit an ATM because the user is travelling on a route that is not near an active ATM, information indicating a health status associated with a ATM access card of the user, and other information that can be specified by user preferences (e.g., in sure data **124**).

FIG. 4 depicts computer system **400**, which is representative of computing device **110** and server **120**, in accordance with an illustrative embodiment of the present invention. It should be appreciated that FIG. 4 provides only an illustration of one implementation and does not imply any limitations with regard to the environments in which different embodiments may be implemented. Many modifications to the depicted environment may be made. Computer system **400** includes processor(s) **401**, cache **403**, memory **402**, persistent storage **405**, communications unit **407**, input/output (I/O) interface(s) **406**, and communications fabric **404**. Communications fabric **404** provides communications between cache **403**, memory **402**, persistent storage **405**, communications unit **407**, and input/output (I/O) interface(s) **406**. Communications fabric **404** can be implemented with any architecture designed for passing data and/or control information between processors (such as microprocessors, communications and network processors, etc.), system memory, peripheral devices, and any other hardware components within a system. For example, communications fabric **404** can be implemented with one or more buses or a crossbar switch.

Memory **402** and persistent storage **405** are computer readable storage media. In this embodiment, memory **402** includes random access memory (RAM). In general, memory **402** can include any suitable volatile or non-volatile computer readable storage media. Cache **403** is a fast memory that enhances the performance of processor(s) **401** by holding recently accessed data, and data near recently accessed data, from memory **402**.

Program instructions and data (e.g., software and data **410**) used to practice embodiments of the present invention may be stored in persistent storage **405** and in memory **402** for execution by one or more of the respective processor(s) **401** via cache **403**. In an embodiment, persistent storage **405** includes a magnetic hard disk drive. Alternatively, or in addition to a magnetic hard disk drive, persistent storage **405** can include a solid state hard drive, a semiconductor storage device, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), a flash memory, or any other computer readable storage media that is capable of storing program instructions or digital information.

The media used by persistent storage **405** may also be removable. For example, a removable hard drive may be used for persistent storage **405**. Other examples include optical and magnetic disks, thumb drives, and smart cards

that are inserted into a drive for transfer onto another computer readable storage medium that is also part of persistent storage **405**. Software and data **410** can be stored in persistent storage **405** for access and/or execution by one or more of the respective processor(s) **401** via cache **403**. With respect to computing device **110**, software and data **410** is representative of user interface **112** and application **114**. With respect to server **120**, software and data **410** is representative of notification program **200**, plan deviation program **300**, user data **124**, and historical ATM data **126**.

Communications unit **407**, in these examples, provides for communications with other data processing systems or devices. In these examples, communications unit **407** includes one or more network interface cards. Communications unit **407** may provide communications through the use of either or both physical and wireless communications links. Program instructions and data (e.g., software and data **410**) used to practice embodiments of the present invention may be downloaded to persistent storage **405** through communications unit **407**.

I/O interface(s) **406** allows for input and output of data with other devices that may be connected to each computer system. For example, I/O interface(s) **406** may provide a connection to external device(s) **408**, such as a keyboard, a keypad, a touch screen, and/or some other suitable input device. External device(s) **408** can also include portable computer readable storage media, such as, for example, thumb drives, portable optical or magnetic disks, and memory cards. Program instructions and data (e.g., software and data **410**) used to practice embodiments of the present invention can be stored on such portable computer readable storage media and can be loaded onto persistent storage **405** via I/O interface(s) **406**. I/O interface(s) **406** also connect to display **409**.

Display **409** provides a mechanism to display data to a user and may be, for example, a computer monitor.

The programs described herein are identified based upon the application for which they are implemented in a specific embodiment of the invention. However, it should be appreciated that any particular program nomenclature herein is used merely for convenience, and thus the invention should not be limited to use solely in any specific application identified and/or implied by such nomenclature.

The present invention may be a system, a method, and/or a computer program product at any possible technical detail level of integration. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions

recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, configuration data for integrated circuitry, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++, or the like, and procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a

computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted in the blocks may occur out of the order noted in the Figures. For example, two blocks shown in succession may, in fact, be accomplished as one step, executed concurrently, substantially concurrently, in a partially or wholly temporally overlapping manner, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

The descriptions of the various embodiments of the present invention have been presented for purposes of illustration but are not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The terminology used herein was chosen to best explain the principles of the embodiment, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the embodiments disclosed herein.

What is claimed is:

1. A method comprising:

determining, by one or more processors, a transaction plan for a user, the transaction plan including a schedule of future transactions of the user based on historical user data and user-provided information, wherein the determined transaction plan includes a forecast future withdrawal amount and corresponding time and wherein determining a transaction plan for a user further comprises:

determining, by one or more processors, whether the user has deviated from the determined transaction plan based on completed transactions of the user;

identifying, by one or more processors, an automated teller machine (ATM) preferred by the user;

determining, by one or more processors, whether the ATM preferred by the user can fulfill the determined trans-

action plan, based on analyzing a current resource supply of the ATM preferred by the user in relation to aggregated transaction plans from one or more other users, the aggregated transaction plans indicating use of the ATM preferred by the user; and

in response to determining that the ATM preferred by the user cannot fulfill the determined transaction plan, determining, by one or more processors, one or more alternate ATMs that can fulfill the determined transaction plan.

2. The method of claim 1, further comprising:

providing, by one or more processors, a notification to the user, the notification including at least a recommendation to utilize the determined one or more alternate ATMs.

3. The method of claim 1, further comprising:

in response to determining that the user has deviated from the determined transaction plan, determining, by one or more processors, an updated transaction plan for the user based on the completed transactions, the updated transaction plan including an updated forecast future withdrawal amount and corresponding time.

4. The method of claim 1, wherein determining whether the ATM preferred by the user can fulfill the determined transaction plan further comprises:

analyzing, by one or more processors, a current resource supply of the ATM preferred by the user and historical usage data for the ATM preferred by the user.

5. The method of claim 1, wherein determining one or more alternate ATMs that can fulfill the determined transaction plan further comprises:

analyzing, by one or more processors, a respective current resource supply of a plurality of candidate alternate ATMs and historical usage data for the plurality of candidate alternate ATMs.

6. The method of claim 1, wherein determining one or more alternate ATMs that can fulfill the determined transaction plan further comprises:

identifying, by one or more processors, at least one candidate alternate ATM that is on a travel path associated with the user.

7. The method of claim 1, wherein determining one or more alternate ATMs that can fulfill the determined transaction plan further comprises:

retrieving, by one or more processors, sensor data from a plurality of candidate alternate ATMs, the sensor data including current resource supply data for respective ATMs of the plurality of candidate alternate ATMs.

8. A computer program product comprising:

one or more computer readable storage media and program instructions stored on the one or more computer readable storage media, the program instructions comprising:

program instructions to determine a transaction plan for a user, the transaction plan including a schedule of future transactions of the user based on historical user data and user-provided information, wherein the determined transaction plan includes a forecast future withdrawal amount and corresponding time and wherein program instructions to determine a transaction plan for a user further comprise program instructions to:

determine whether the user has deviated from the determined transaction plan based on completed transactions of the user;

program instructions to identify an automated teller machine (ATM) preferred by the user;

17

program instructions to determine whether the ATM preferred by the user can fulfill the determined transaction plan, based on analyzing a current resource supply of the ATM preferred by the user in relation to aggregated transaction plans from one or more other users, the aggregated transaction plans indicating use of the ATM preferred by the user; and

in response to determining that the ATM preferred by the user cannot fulfill the determined transaction plan, program instructions to determine one or more alternate ATMs that can fulfill the determined transaction plan.

9. The computer program product of claim 8, further comprising program instructions, stored on the one or more computer readable storage media, to:

provide a notification to the user, the notification including at least a recommendation to utilize the determined one or more alternate ATMs.

10. The computer program product of claim 8, further comprising program instructions, stored on the one or more computer readable storage media, to:

in response to determining that the user has deviated from the determined transaction plan, determine an updated transaction plan for the user based on the completed transactions, the updated transaction plan including an updated forecast future withdrawal amount and corresponding time.

11. The computer program product of claim 8, wherein the program instructions to determine whether the ATM preferred by the user can fulfill the determined transaction plan further comprise program instructions to:

analyze a current resource supply of the ATM preferred by the user and historical usage data for the ATM preferred by the user.

12. The computer program product of claim 8, wherein the program instructions to determine one or more alternate ATMs that can fulfill the determined transaction plan further comprise program instructions to:

analyze a respective current resource supply of a plurality of candidate alternate ATMs and historical usage data for the plurality of candidate alternate ATMs.

13. A computer system comprising:

one or more computer processors;

one or more computer readable storage media; and

program instructions stored on the computer readable storage media for execution by at least one of the one or more processors, the program instructions comprising:

program instructions to determine a transaction plan for a user, the transaction plan including a schedule of future transactions of the user based on historical user data and user-provided information, wherein the determined transaction plan includes a forecast future withdrawal amount and corresponding time and wherein program instructions to determine a transaction plan for a user further comprise program instructions to:

18

determine whether the user has deviated from the determined transaction plan based on completed transactions of the user;

program instructions to identify an automated teller machine (ATM) preferred by the user;

program instructions to determine whether the ATM preferred by the user can fulfill the determined transaction plan, based on analyzing a current resource supply of the ATM preferred by the user in relation to aggregated transaction plans from one or more other users, the aggregated transaction plans indicating use of the ATM preferred by the user; and

in response to determining that the ATM preferred by the user cannot fulfill the determined transaction plan, program instructions to determine one or more alternate ATMs that can fulfill the determined transaction plan.

14. The computer system of claim 13, further comprising program instructions, stored on the computer readable storage media for execution by at least one of the one or more processors, to:

provide a notification to the user, the notification including at least a recommendation to utilize the determined one or more alternate ATMs.

15. The computer system of claim 13, further comprising program instructions, stored on the computer readable storage media for execution by at least one of the one or more processors, to:

in response to determining that the user has deviated from the determined transaction plan, determine an updated transaction plan for the user based on the completed transactions, the updated transaction plan including an updated forecast future withdrawal amount and corresponding time.

16. The computer system of claim 13, wherein the program instructions to determine whether the ATM preferred by the user can fulfill the determined transaction plan further comprise program instructions to:

analyze a current resource supply of the ATM preferred by the user and historical usage data for the ATM preferred by the user.

17. The computer system of claim 13, wherein the program instructions to determine one or more alternate ATMs that can fulfill the determined transaction plan further comprise program instructions to:

analyze a respective current resource supply of a plurality of candidate alternate ATMs and historical usage data for the plurality of candidate alternate ATMs.

18. The computer system of claim 13, wherein the program instructions to determine one or more alternate ATMs that can fulfill the determined transaction plan further comprise program instructions to:

identify at least one candidate alternate ATM that is on a travel path associated with the user.

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